

IN THE CLAIMS

1. (Currently Amended) A storage apparatus comprising:

connection means for connecting to a computer in which a database management system operates; and

information acquiring means for acquiring information of data structures including tables, indexes, and logs defined by schema in said database management system, and information of recording positions of data of a database in said storage apparatus that are managed by said database management system and grouped under each of said data structures defined by said schema;

at least one physical storage device for storing data;

logical-to-physical position conversion means by which logical storage positions used when said computer makes access to said storage apparatus are converted to physical storage positions at which data can be actually stored within said physical storage device;

data allocation changing means for changing said physical storage positions within said at least one physical

storage device corresponding to said logical storage positions; and

allocation changing plan generation means for generating a plan for changing the physical storage positions of data corresponding to said logical storage positions by using said information acquired by said information acquiring means.

2. (Original) A storage apparatus according to claim 1, wherein said connection means is used to connect to said computer in which a plurality of said database management systems operate.

3. (Currently Amended) A storage apparatus according to claim 1, wherein said connection means is used to connect to a plurality of said computers in which said database management system-operates operates.

4. (Original) A storage apparatus according to claim 1, wherein said information acquiring means acquires information

of said database managed by a plurality of said database management systems.

5. (Original) A storage apparatus according to claim 1, wherein said information acquiring means acquires said information by using said connection means.

6. (Original) A storage apparatus according to claim 1, wherein said information acquiring means acquires information of said database that said database management system manages from said database management system.

7. (Original) A storage apparatus according to claim 1, wherein said information acquiring means acquires information of said database that said database management system manages through at least one program different from said database management system.

8. (Canceled).

9. (Currently Amended) A storage apparatus according to claim 8~~1~~, further comprising automatic data relocation means for automatically changing data allocation by use of said allocation changing means and according to said plan produced by said allocation changing plan generation means.

10. (Currently Amended) A storage apparatus ~~according to claim 8,~~ comprising:

connection means for connecting to a computer in which a database management system operates; and

information acquiring means for acquiring information of data structures including tables, indexes, and logs defined by schema in said database management system, and information of recording positions of data of a database in said storage apparatus that are managed by said database management system and grouped under each of said data structures defined by said schema;

at least one physical storage device for storing data;

logical-to-physical position conversion means by which logical storage positions used when said computer makes

access to said storage apparatus are converted to physical storage positions at which data can be actually stored within said physical storage device;

data allocation changing means for changing said physical storage positions within said at least one physical storage corresponding to said logical storage positions; and

allocation changing plan generation means for generating a plan for changing the physical storage positions of data corresponding to said logical storage positions by using said information acquired by said information acquiring means,

wherein said allocation changing plan generation means decides places to access and the order to access when said database management system makes access to said database sequentially on the basis of said information acquired by said information acquiring means, and makes data of said sequentially accessed data in said database be placed in continuous regions on said physical storage device in order that said data can be matched to said sequential access order.

11. (Currently Amended) A storage apparatus ~~according to claim 8, comprising:~~

connection means for connecting to a computer in which a database management system operates; and

information acquiring means for acquiring information of data structures including tables, indexes, and logs defined by schema in said database management system, and information of recording positions of data of a database in said storage apparatus that are managed by said database management system and grouped under each of said data structures defined by said schema;

at least one physical storage device for storing data;

logical-to-physical position conversion means by which logical storage positions used when said computer makes access to said storage apparatus are converted to physical storage positions at which data can be actually stored within said physical storage device;

data allocation changing means for changing said physical storage positions within said at least one physical storage corresponding to said logical storage positions; and

allocation changing plan generation means for generating a plan for changing the physical storage positions of data corresponding to said logical storage positions by using said information acquired by said information acquiring means, wherein:

said information acquired by said information acquiring means further includes information of degree of parallelism used when said database management system makes access to data of said database that belong to the same one of said data structures defined by said schema, and

said allocation changing plan generation means makes data of said database that belong to the same one of said data structures defined by said schema be placed on a plurality of said physical storage devices on the basis of said acquired information.

12. (Currently Amended) A storage apparatus ~~according to claim 8, comprising:~~

connection means for connecting to a computer in which a database management system operates; and

information acquiring means for acquiring information of data structures including tables, indexes, and logs defined by schema in said database management system, and information of recording positions of data of a database in said storage apparatus that are managed by said database management system and grouped under each of said data structures defined by said schema;

at least one physical storage device for storing data;

logical-to-physical position conversion means by which logical storage positions used when said computer makes access to said storage apparatus are converted to physical storage positions at which data can be actually stored within said physical storage device;

data allocation changing means for changing said physical storage positions within said at least one physical storage corresponding to said logical storage positions; and

allocation changing plan generation means for generating a plan for changing the physical storage positions of data corresponding to said logical storage positions by using said information acquired by said information acquiring

means, wherein said allocation changing plan generation means detects a set of data of said database that are highly likely to be simultaneously accessed, and allocates said set of data on said different physical storage devices on the basis of said acquired information.

13. (Currently Amended) A storage apparatus according to claim 12, wherein said allocation changing plan generation means extracts table data and index data associated with said table data, and registers said table and index data as a set of said data of said database that are highly likely to be accessed at a time when said index is a free-structured index.

14. (Original) A storage apparatus according to claim 12, wherein information of said database includes information of history of execution that said database management system has made so far.

15. (Original) A storage apparatus according to claim 12, further comprising physical storage device operation information acquiring means for acquiring the operation

information of said physical storage devices, wherein said allocation changing plan generation means utilizes said operation information acquired by said physical storage device operation information acquiring means.

16. (Currently Amended) A storage apparatus according to claim 12, wherein said allocation changing plan generation means registers log data to be recorded when said database management system updates data and other data of said database, as a set of said data of said database that are highly likely to be accessed at a time.

17. (Currently Amended) A storage apparatus according to claim 1, further comprising:

~~at least one physical storage device for storing data and a cache memory; and~~

cache memory control means for controlling said cache memory by using said information acquired by said information acquiring means, wherein the information acquired by said information acquiring means further includes a method of controlling data of said database that said database

management system executes on a host cache that said computer has on its memory, and computer cache data information associated with the amount of data of said host cache.

18. (Original) A storage apparatus according to claim 17, wherein said cache memory control means compares said amount of computer cache data that are associated with said data structures defined by said schema and cached on said computer memory, and the size of actual data of said data structures, and decides the priority with which the data stored at storage positions of said actual data of said data structures are cached by using said compared results.

19. (Original) A storage apparatus according to claim 17, wherein said cache memory control means compares said amount of computer cache data of said data structures and the usable amount of said cache memory to data belonging to said data structures in said storage apparatus, and decides the priority with which the data stored at the storage positions of said actual data of said data structures are cached by using said compared results.

20. (Currently Amended) A method of changing storage positions of data stored within a plurality of physical storage devices by a control unit in a storage apparatus that has connection means for connecting to a computer in which a database management system (DBMS) operates and to administrator's terminals, said plurality of physical storage devices for storing data of said DBMS, said control unit for controlling said storage apparatus and a memory useful for said control unit to control, said method comprising the steps of:

storing in said memory first information of physical storage positions of said data stored in said plurality of physical storage devices;

acquiring second information about the database processing that said DBMS makes through said connection means, and storing said second information in said memory;

converting, when said computer makes access to said storage apparatus, logical storage positions to physical storage positions at which data can be actually stored within said physical storage devices and changing said physical

storage positions within said physical storage devices
corresponding to said logical storage positions;
generating an allocation changing plan for changing
the physical storage positions of data corresponding to said
logical storage positions by using information of data
structures including tables, indexes, and logs defined by
schema in said database management system;

generating a plan for making data relocation between
said plurality of physical storage devices in order to improve
the performance of access to data in said database processing
that said DBMS makes on the basis of said first and second
information; and

displaying said relocation plan on the display
screens of said administrator's terminals through said
connection means.

21. (Original) A method according to claim 20, further
comprising the step of executing said relocation plan in
response to an instruction transmitted through said connection
means from said administrator's terminals.

22. (Currently Amended) A method of changing storage positions of data stored within a plurality of physical storage devices by a control unit in a storage apparatus that has connection means for connecting to a computer in which a database management system (DBMS) operates and to administrator's terminals, said plurality of physical storage devices for storing data of said DBMS, a data cache for said data, said control unit for controlling said storage apparatus and a memory useful for said control unit to control, said method comprising the steps of:

storing in said memory first information of physical storage positions of said data stored in said plurality of physical storage devices;

acquiring second information about the database processing that said DBMS makes through said connection means, and storing said second information in said memory;

converting, when said computer makes access to said storage apparatus, logical storage positions to physical storage positions at which data can be actually stored within said physical storage devices and changing said physical

storage positions within said physical storage devices
corresponding to said logical storage positions;
generating an allocation changing plan for changing
the physical storage positions of data corresponding to said
logical storage positions by using information of data
structures including tables, indexes, and logs defined by
schema in said database management system;

generating a plan for making data relocation between
said plurality of physical storage devices in order to improve
the performance of access to data in said database processing
that said DBMS makes on the basis of said first and second
information; and

displaying said relocation plan on the display
screens of said administrator's terminals through said
connection means.

23. (New) A storage apparatus according to claim 1,
wherein said allocation changing plan means creates said plan
for changing the physical storage positions of data
corresponding to said logical storage positions, according to
a characteristic of said at least one physical storage device.

24. (New) A storage apparatus according to claim 23, wherein said allocation changing plan means creates said plan for changing the physical storage positions of data corresponding to said logical storage positions, according to an access frequency to said storage apparatus by an application using said storage apparatus.